A Second Look

An Easy Way to Cut the Cost of Live-Fire Gunnery Evaluation

by Dr. Joseph D. Hagman

In the 1999 March-April issue of *ARMOR*,[1] Dr. Monte Smith and I proposed a strategy for freeing up about 20% of the ammunition, range time, and operational tempo (OPTEMPO) resources typically spent on Tank Table VIII (TTVIII). The strategy did so by enabling armor unit commanders to predict which of their crews would, and would not, first-run qualify (Q1) — *before* they had fired all ten engagements. Predictions were based on cutoff scores against which crew performance was compared after each engagement was fired. The fewer the number of engagements that needed to be fired before a prediction could be made, the greater the resource savings would be.

Soon after we developed the strategy, the TTVIII engagements used to derive its predictions were changed.[2] Consequently, the cutoff scores have had to be updated and the strategy revised accordingly. In reading on, you'll find out how the revised strategy works, what the new cutoff scores are, and how much can be saved by using this strategy. The analysis is based on TTVIII data collected from 171 M1A2 tank crews stationed at Fort Hood, Texas.

How the Revised Strategy Works

Like the initial strategy, the revised version uses cutoff scores to predict crew qualification status as early into the TTVIII engagement firing sequence as possible. These predictions are then used to qualify crews predicted to fire 700 or more, as well as to send predicted nonqualifiers back for remedial training — two actions that until now have had to await the firing of all ten engagements.

Table 1 shows the new cutoff score values associated with the firing of from two to nine engagements. Crews scoring lower than the values listed in the middle column would be predicted to first-run qualify no more than 5% of the time, if they were to go ahead and fire all ten engagements. Those scoring equal to, or higher than, the values listed in the right column would be predicted to Q1 at least 95% of the time. Crews scoring in between these values would go on to fire the next engagement.

The resulting predictions will apply to whatever set of ten TTVIII engagements are fired, just as long as the selection and firing order of engagements are not based on their expected difficulty. Thus, neither the training program leading up to TTVIII firing, nor the table's engagement scenario itself need to be modified for the predictions to hold up.

Implementing the Strategy

The flowchart in Figure 1 shows one way the proposed strategy might be implemented in the unit using the cutoff scores in Table 1. All crews would begin TTVIII by firing the first two of the ten scheduled engagements. Those scoring lower than 114 would be pulled from the range and given remedial training, perhaps on the Conduct-of-Fire Trainer (COFT) or Abrams Full-Crew Interactive Simulation Trainer (AFIST). Following remediation, they would be given one rerun attempt, starting at the top with the first two engagements.

First-run crews scoring 166 or higher after the first two engagements would be awarded early qualification (Q1e); those scoring from 114 to 165 would go on to the third engagement. Crews scoring lower than 172 after three engagements would undergo remediation before beginning their rerun from the top. Rerun crews would be evaluated as if they were firing their first run, except that predictions would now apply to Q2 rather than Q1. Those predicted to need remediation as a result of low scores on their rerun would receive an unqualified rating. First-run crews scoring 248 or higher after three engagements would be awarded early qualification; those scoring between 172 and 247 would go on to the fourth engagement, and so on.

Of course, other implementation approaches are possible. A commander might, for example, want to delay making any predictions until after his crews have fired at least five engagements. While the cutoff scores will apply under either implementation approach, the former is likely to be more cost effective.

What's the Payoff?

Generally speaking, the earlier in the TTVIII engagement firing sequence that predictions can be made, the greater the resource savings will be. Assuming that each engagement accounts for roughly 10% of the total resources spent on TTVIII, crews predicted to Q1 after only two engagements would save about 80% of the resources needed to fire all ten. Those predicted to Q1 after three engagements would save about 70%, and so on.

Resources can be saved by predicted Q1 crews as well as by those predicted to need remediation. Using the current

# of Engagements Fired	Remediation Cutoff Scores (<)	Q1 Cutoff Scores (≥)
2	114	166
3	172	248
4	234	326
5	299	401
6	363	477
7	435	545
8	511	609
9	587*	673

*mathematically eliminated

Table 1. Cutoff Scores For Remediation and Q1 Predictions

tank crew sample, we calculated (a) the number of crews in a 44-crew battalion that would be predicted to Q1 after each engagement, and (b) the predicted number of engagements they would save. As shown in Table 2, the five crews in the current sample predicted to Q1 after two engagements would save a total of 40 engagements (5 crews x 8 engagements = 40), the three crews predicted to Q1 after three engagements would save 21 engagements, and so on, with 88 engagements saved in all by the entire battalion. Thus, on predicted Q1 crews alone, 20% (88/440) of an armor battalion's first-run engagements could be saved merely by applying the proposed evaluation strategy.

Battalion resources should also be saved in cases of crews predicted to need remedial training simply because they can be identified before they've fired all ten engagements. Just exactly how much savings, however, would depend on how many rerun engagements are fired. Having crews start their reruns from the top, and then re-applying the cutoff-score values, should help to maximize the savings on the rerun attempt. Thus, in general, reducing the number of engagements fired through early prediction of which crews will, and which won't, first-run qualify should translate into less range time, fewer rounds, and reduced OPTEMPO costs each year on TTVIII.

# of Engagements Fired	Predicted # of Early Q1 Crews	Predicted # of Engagements Saved
2	5	40
3	3	21
4	1	6
5	1	5
6	1	4
7	1	3
8	3	6
9	3	3
	Total: 18	**Total: 88**

Table 2. Predicted # of engagements saved by an armor battalion on the first run of TTVIII

Final Thoughts

The updated strategy proposed here shows that the cost of crew-level tank gunnery evaluation can indeed be cut considerably by simply changing the content of TTVIII, to include fewer engagements, as well its structure, to include performance cutoff scores or "gates" to support early qualification and remediation decisions. The resulting savings can be used to offset any future resource cuts, be pocketed, or be used for other purposes, such as platoon-level gunnery.

As of now, this strategy applies only to Active Component (AC) tank crews because no Reserve Component (RC) crews were included in the current analyses. Although the specific cutoff score values for early qualification and remediation decisions, as well as the size of expected cost cuts, may change somewhat from those reported here, we've already shown that the use of cutoff scores for prediction purposes works for the RC with the old TTVIII engagements.[3] So, there appears to be little reason why it won't work with the new engagements. We'll just have to wait and see how well.

In the meantime, more efficient AC tank gunnery evaluation on TTVIII is possible by evaluating crew performance as each engagement is fired, rather than waiting until the firing of all ten. In today's do-more-with-less environment, more efficient ways are needed for training and evaluating tank gunnery. The strategy proposed here is an easy, albeit controversial, way of doing so that we think will work without jeopardizing the purpose and results of the TTVIII evaluation process.

We'd like to hear your thoughts. You can reach us by regular mail at the U.S. Army Research Institute, 1910 University Drive, Boise, ID 83725, by telephone at (208) 334-9390, or by e-mail at *Hagman@ari.army.mil.*

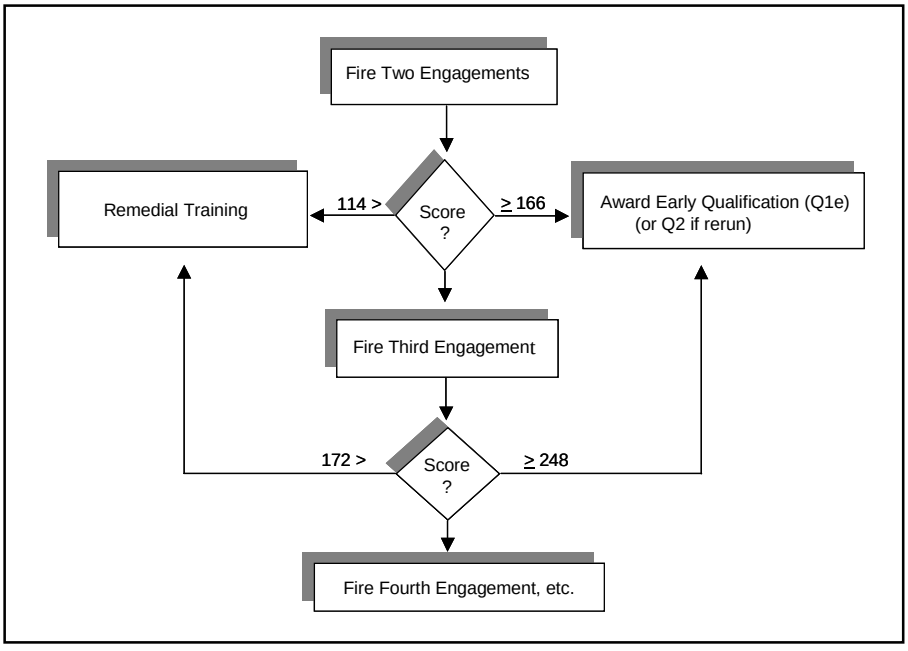

Figure 1. Flowchart of TTVIII engagement sequence.

Notes

[1]Hagman, J.D. and Smith, M.D., "How the Guard Could Cut Costs on Table VIII Without Really Trying," *ARMOR*, March-April 1999, pp. 47-48.

[2]Department of the Army, *FM 17-12-1-2, Tank Gunnery Training (Abrams)*, 1998, Washington, D.C.

[3]Hagman and Smith.

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